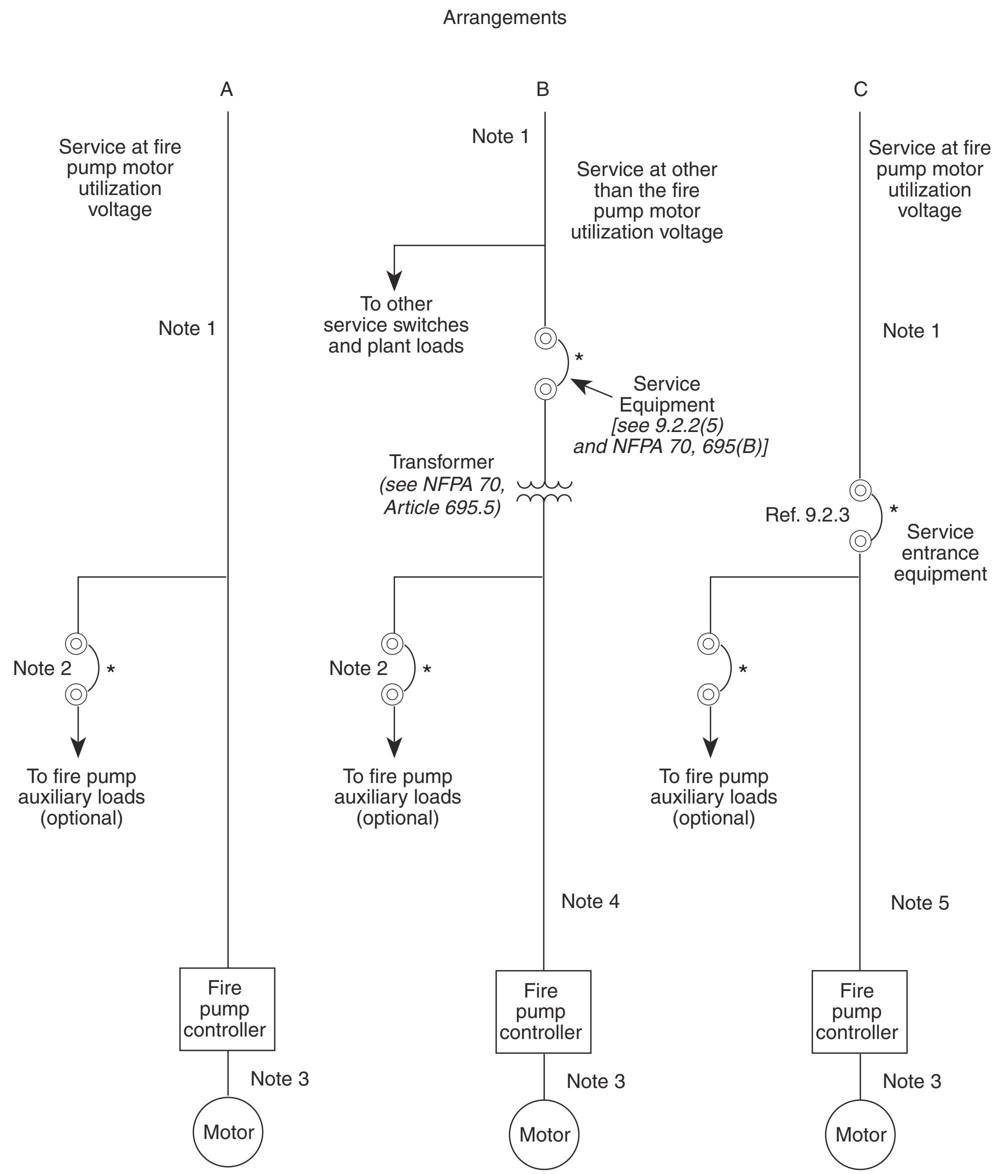


*Circuit breakers or fusible switches can be used.
Note 1: Service conductors *(see NFPA 70, Article 230)*
Note 2: Overcurrent protection (SUSE rated) per *NFPA 70*, Article 240 or 430
Note 3: Branch circuit conductors *[see NFPA 70, 695.6(B)(2)]*
Note 4: Feeder conductors *[see NFPA 70, 695.6(B)(2)]*
Note 5: Dedicated feeder connection *[see 9.2.2(3)]*

Δ FIGURE A.9.2 Typical Power Supply Arrangements from Source to Motor.

Surge Arresters for Alternating Current Power Circuits (>1 kV), are normally zinc-oxide without gaps.

A.10.4.2.1.2 For more information, see *NFPA 70.*

A.10.4.2.3 For more information, see *NFPA 70.*

A.10.4.3.1 For more information, see *NFPA 70*, Article 100.

A.10.4.3.3 Attention should be given to the type of service grounding to establish circuit breaker interrupting rating based on grounding type employed.

A.10.4.3.3.1(4) The interrupting rating can be less than the suitability rating where other devices within the controller assist in the current-interrupting process.

A.10.4.3.3.1.1 The isolating switch is not allowed to trip either. See also 10.4.2.1.3.

A.10.4.3.3.1.2 See also A.10.4.3.3.1.1.

A.10.4.3.3.2 Current limiters are melting link-type devices that, where used as an integral part of a circuit breaker, limit the current during a short circuit to within the interrupting capacity of the circuit breaker.

A.10.4.4(4) It is recommended that the locked rotor overcurrent device not be reset more than two consecutive times if tripped due to a locked rotor condition without the motor first being inspected for excessive heating and to alleviate or eliminate the cause preventing the motor from attaining proper speed.

A.10.4.5.7 The signal should incorporate local visible indication and contacts for remote indication. The signal can be incorporated as part of the power available indication and loss of phase signal. *(See 10.4.6.1 and 10.4.7.2.2.)*

A.10.4.6 The pilot lamp for signal service should have operating voltage less than the rated voltage of the lamp to ensure long operating life. When necessary, a suitable resistor or potential transformer should be used to reduce the voltage for operating the lamp.

A.10.4.7 Where unusual conditions exist whereby pump operation is not certain, a "failed-to-operate" fire pump alarm is recommended. In order to supervise the power source for the fire pump alarm circuit, the controller can be arranged to start upon failure of the supervised alarm circuit power.

A.10.5.1 The following definitions are derived from *NFPA 70*:

(1) *Automatic*. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature, or mechanical configuration.
(2) *Nonautomatic*. Action requiring intervention for its control. As applied to an electric controller, nonautomatic control does not necessarily imply a manual controller, but only that personal intervention is necessary.

A.10.5.2.1 Installation of the pressure sensing line between the discharge check valve and the control valve is necessary to facilitate isolation of the jockey pump controller (and sensing line) for maintenance without having to drain the entire system. *[See Figure A.4.32(a) and Figure A.4.32(b).]*

N **A.10.5.2.1.1.2** Water piping and associated devices could be attached to the outside of the controller.

A.10.5.2.1.3 The purpose of monitoring the pressure transducer is to detect if a transducer has drifted upwardly from zero over time. A transducer that drifts downwardly will automatically cause the fire pump to start when it drifts below the start set point.

A.10.5.2.1.3.1 When the solenoid valve drain opens, the restricting orifice in the pressure sensing line will keep the pressure at the transducer near zero while the solenoid valve is open. This is the time when the transducer can be verified to be less than 10 psi.

A.10.5.2.1.3.2 The purpose of monitoring the pressure reading from a pressure transducer is to detect and correct a transducer that is operating outside of the expected pressure range.

A.10.5.2.1.8.2 The pressure recorder should be able to record a pressure at least 150 percent of the pump discharge pressure under no-flow conditions. In a high-rise building, this requirement can exceed 400 psi (27.6 bar). This pressure recorder should be readable without opening the fire pump controller enclosure. This requirement does not mandate a separate recording device for each controller. A single multichannel recording device can serve multiple sensors. If the pressure recording device is integrated into the pressure controller, the pressure sensing element should be used to record system pressure.

A.10.5.3.2 The emergency-run mechanical control provides means for externally and manually closing the motor contactor across-the-line to start and run the fire pump motor. It is intended for emergency use when normal electric/magnetic operation of the contactor is not possible.

When so used on controllers designed for reduced-voltage starting, the 15 percent voltage drop limitation in Section 9.4 is not applicable.

Δ **A.10.5.4.2.1(1)** Although the pump is allowed to start and stop automatically during churn testing, 4.3.1 requires qualified person(s) to be in the pump room to monitor conditions while the pump is running.

A.10.8 Typical fire pump controller and transfer switch arrangements are shown in Figure A.10.8. Other configurations can also be acceptable.

A.10.8.2 The compartmentalization or separation is to prevent propagation of a fault in one compartment to the source in the other compartment.

A.10.8.3.11 Internal protection refers to any tripping elements contained within the switching mechanism of the transfer switch. This is to prevent a switching mechanism from inhibiting transfer of power.

A.10.10 See Figure A.10.10.

A.10.10.3 The bypass path constitutes all of the characteristics of a non-variable speed fire pump controller.

A.10.10.3.1 The bypass contactor should be energized only when there is a pump demand to run and the variable speed pressure limiting control or variable speed suction limiting control is in the fault condition.

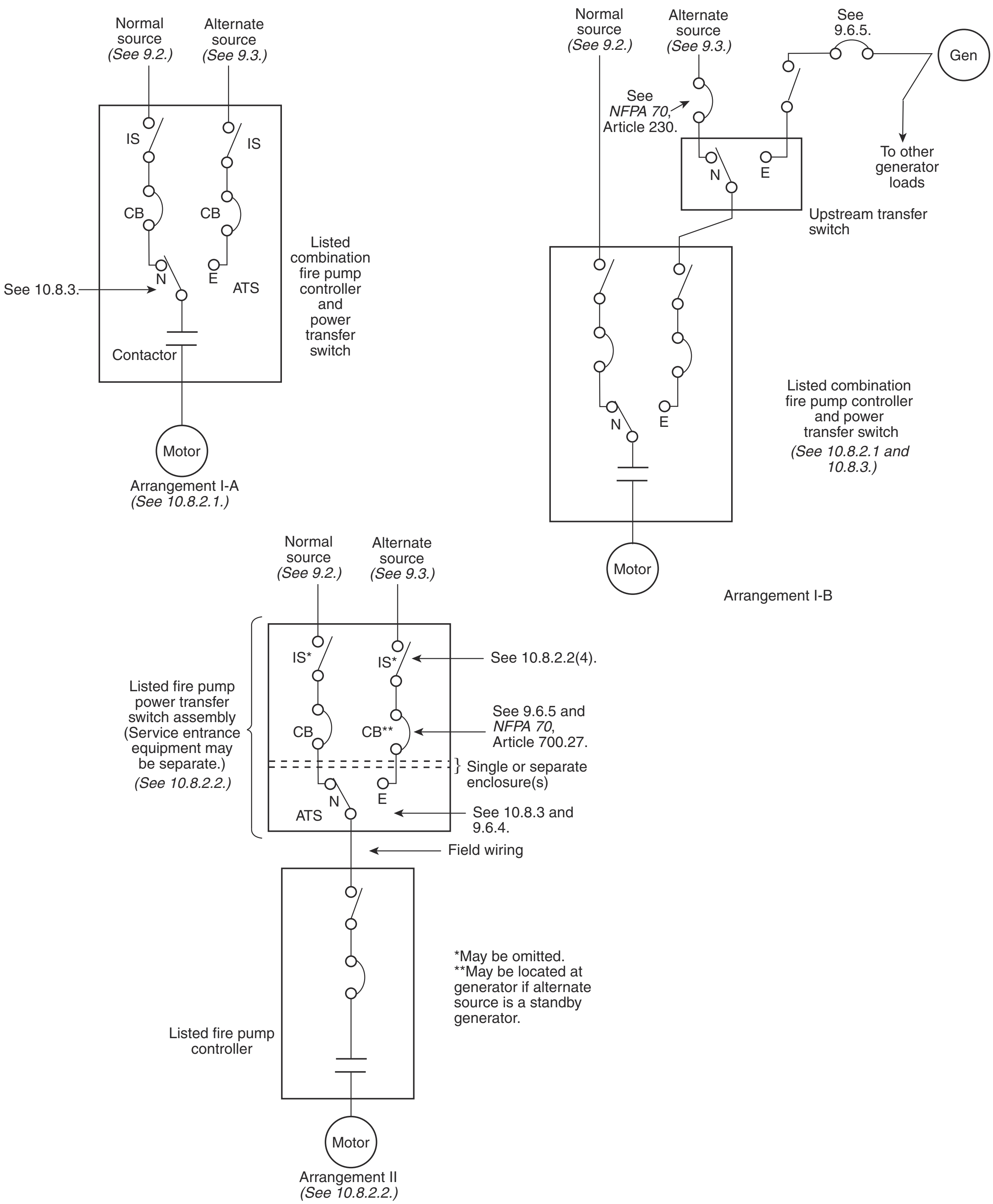
A.10.10.3.1.2 Variable speed drive units (VSDs) should have a positive means of indicating that the drive is operational within a few seconds after power application. If the VSD fails, there is no need to wait for the low pressure bypass time of 10.10.3.1.1.

A.10.10.3.1.3 A motor running at a reduced frequency cannot be connected immediately to a source at line frequency without creating high transient currents that can cause tripping of the fire pump circuit breaker. It is also important to take extra care not to connect (back feed) line frequency power to the VSD since this will damage the VSD and, more important, can cause the fire pump circuit breaker to trip, which takes the pump out of service.

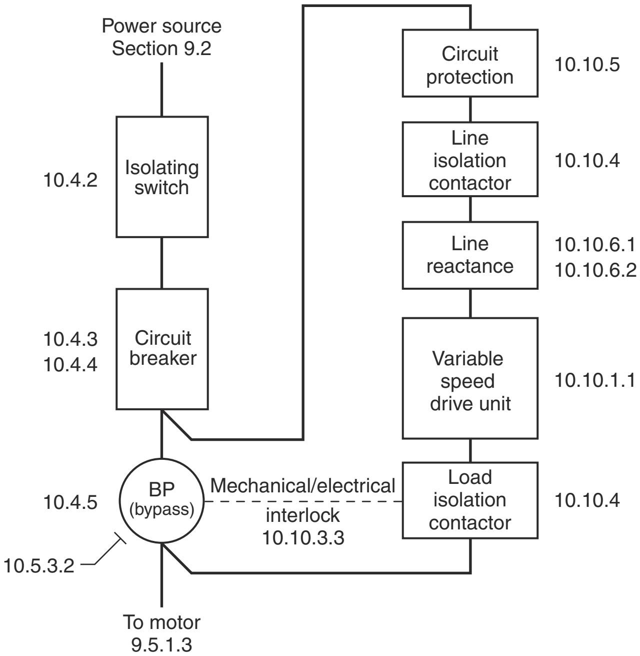
A.10.10.5 The intent is to prevent tripping of the fire pump controller circuit breaker due to a variable speed drive failure and thus maintain the integrity of the bypass circuit.

A.10.10.6.2 As the motor cable length between the controller and motor increases, the VSD high frequency switching voltage transients at the motor will increase. To prevent the transients from exceeding the motor insulation ratings, the motor manufacturer's recommended cable lengths must be followed.

A.10.10.10.1 This allows for field adjustments to reduce hunting, excessive overshooting, or oscillating.



Δ FIGURE A.10.8 Typical Fire Pump Controller and Transfer Switch Arrangements.

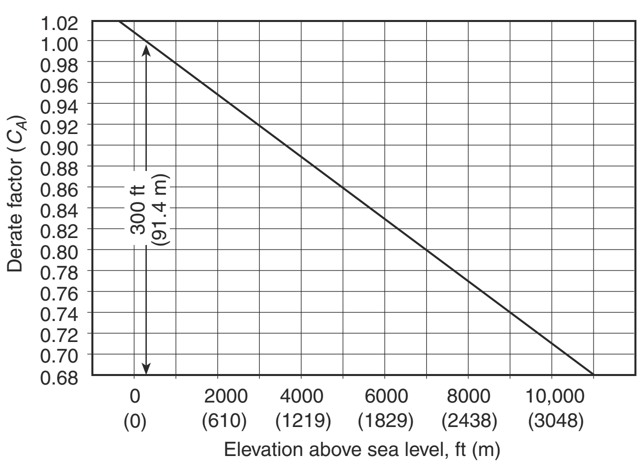


Δ **FIGURE A.10.10 Variable Speed Pressure Limiting Control.**

A.11.1.3 The compression ignition diesel engine has proved to be the most dependable of the internal combustion engines for driving fire pumps.

A.11.2.2.2 For more information, see SAE J-1349, *Engine Power Test Code — Spark Ignition and Compression Engine*. The 4-hour minimum power requirement in NFPA 20 has been tested and witnessed during the engine listing process.

A.11.2.2.4 See Figure A.11.2.2.4.



Note: The correction equation is as follows:

Corrected engine horsepower = $(C_A + C_T - 1) \times$ listed engine horsepower where:

C_A = derate factor for elevation

C_T = derate factor for temperature

FIGURE A.11.2.2.4 Elevation Derate Curve.

A.11.2.2.5 Pump room temperature rise should be considered when determining the maximum ambient temperature specified. *(See Figure A.11.2.2.5.)*

A.11.2.4.2 Traditionally, engines have been built with mechanical devices to control the injection of fuel into the combustion chamber. To comply with requirements for reduced exhaust emissions, many engine manufacturers have incorporated electronics to control the fuel injection process, thus eliminating levers and linkages. Many of the mechanically controlled engines are no longer manufactured.

A.11.2.4.2.4 ECMs can be designed by engine manufacturers to monitor various aspects of engine performance. A stressed engine condition (such as high cooling water temperature) is usually monitored by the ECM and is built into the ECM control logic to reduce the horsepower output of the engine, thus providing a safeguard for the engine. Such engine safeguards are not permitted for ECMs in fire pump engine applications.

A.11.2.4.2.7.1 When engines are in standby and the battery chargers have the batteries in float, it is actually the chargers that are providing the current to support the engine, controller, and pump room as defined in 11.2.7.2.3.2.

A.11.2.4.3.4.3 Some variable speed pressure limiting control systems require a small flow of water through the sensing line. The design of the sensing line connection to the fire water pipe should consider the prevention of contamination. Connecting the sensing line in a horizontal plane to the side of the fire water pipe is a desirable location.

A.11.2.6.1.1 A harness on the enclosure will ensure ready wiring in the field between the two sets of terminals.

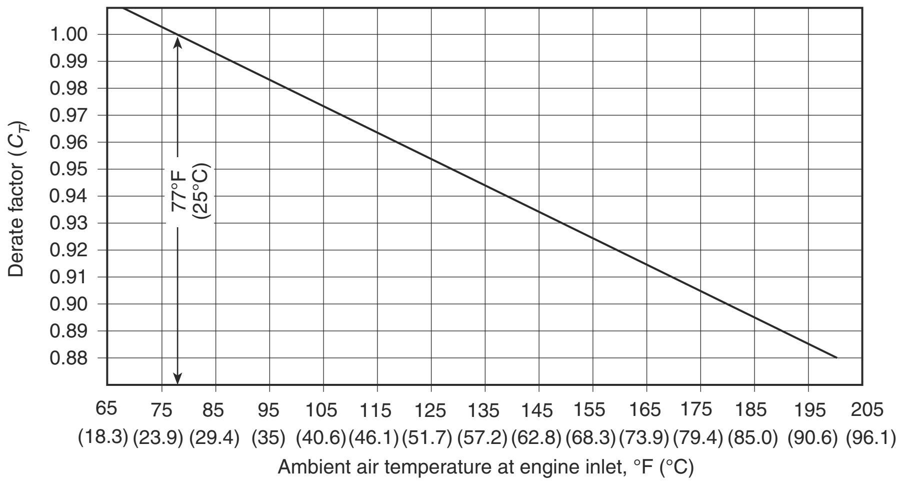
A.11.2.6.2 Terminations should be made using insulated ring-type compression connectors for post-type terminal blocks. Saddle-type terminal blocks should have the wire stripped with about $\frac{1}{16}$ in. (1.6 mm) of bare wire showing after insertion in the saddle, to ensure that no insulation is below the saddle. Wires should be tugged to ensure adequate tightness of the termination.

N **A.11.2.7.2.1.2** There are two different types of lead-acid batteries: vented (flooded) cells and valve-regulated lead-acid (VRLA) cells. The flooded cell has electrodes immersed in liquid electrolyte and allows the products of electrolysis and evaporation to escape freely into the atmosphere as they are generated. The VRLA cell, which is lower maintenance than the flooded type, is sealed, with the exception of a valve that opens to the atmosphere when the internal pressure in the cell exceeds atmospheric pressure by a pre-selected amount. The VRLA cell provides a means for recombination of internally generated oxygen and the suppression of hydrogen gas evolution to limit water consumption.

If batteries are going to be on-site for an extended period of time before being put into service, they should be of the flooded type in a dry charge condition. These batteries can then be wet down with electrolyte and charged just prior to use. VRLA batteries should only be brought to the site in a charged condition just prior to use.

N **A.11.2.7.2.1.4** The combination of battery unit A and battery unit B provides sufficient capacity for a total of 12 consecutive cycles of 15 seconds of cranking and 15 seconds of rest. The controller will complete six of these cycles before stopping the

 Shaded text = Revisions. Δ = Text deletions and figure/table revisions. • = Section deletions. *N* = New material.



Note: The correction equation is as follows:

Corrected engine horsepower = $(C_A + C_T - 1) \times$ listed engine horsepower

where:

C_A = derate factor for elevation

C_T = derate factor for temperature

FIGURE A.11.2.2.5 Temperature Derate Curve.

attempt to start and sending the failure-to-start alarm. Battery units A and B are sized to have sufficient capacity to provide another full cranking cycle in an attempt to get the engine started after the operator has taken corrective action.

A.11.2.7.2.1.6 The 72-hour requirement is intended to apply when batteries are new. Some degradation is expected as batteries age.

A.11.2.7.2.2 Manual mechanical operation of the main battery contactor will bypass all of the control circuit wiring within the controller.

A.11.2.7.2.4 Location at the side of and level with the engine is recommended to minimize lead length from battery to starter.

A.11.2.7.2.5 A single charger that automatically alternates from one battery to another can be used on two battery installations.

N **A.11.2.7.3.2** The enclosed hydraulic accumulator system should be installed as close to the engine as practical so as to prevent significant pressure loss between the engine and the hydraulic accumulator system.

A.11.2.7.4.4 Automatic maintenance of air pressure is preferable.

A.11.2.8.5 See Figure A.11.2.8.5. Water supplied for cooling the heat exchanger is sometimes circulated directly through water-jacketed exhaust manifolds or engine aftercoolers, or both, in addition to the heat exchangers.

A.11.2.8.5.3.8(A) See Figure A.11.2.8.5.3.8(A).

A.11.2.8.5.3.8(B) See Figure A.11.2.8.5.3.8(B).

A.11.2.8.6 Where the water supply can be expected to contain foreign materials, such as wood chips, leaves, lint, and so forth,

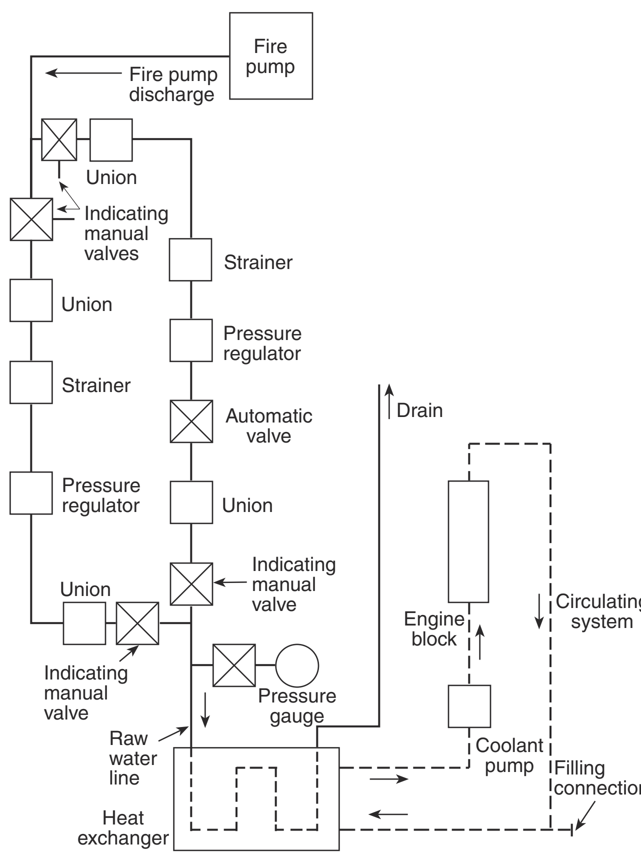


FIGURE A.11.2.8.5 Cooling Water Line with Bypass.

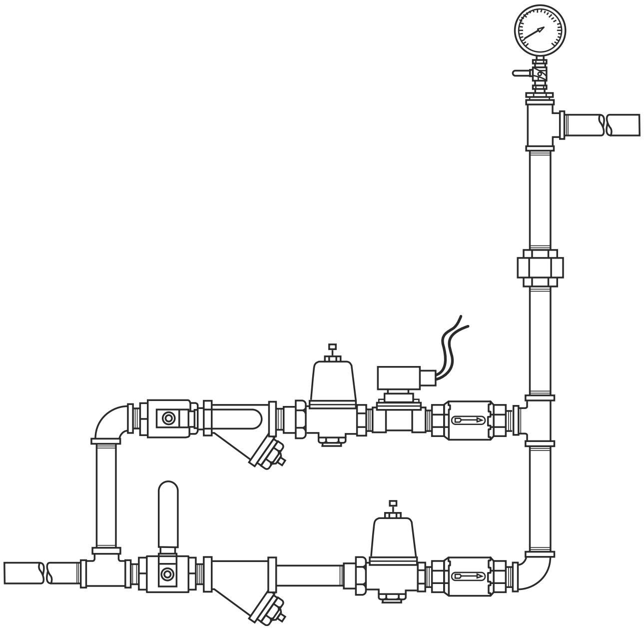


FIGURE A.11.2.8.5.3.8(A) Spring-Loaded Check Valve Arrangement.

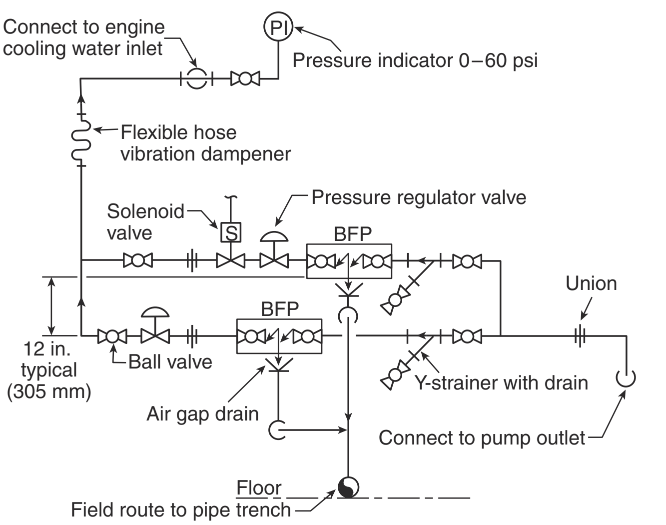


FIGURE A.11.2.8.5.3.8(B) Backflow Preventer Arrangement.

the strainers required in 11.2.8.5 should be of the duplex filter type. Each filter (clean) element should be of sufficient filtering capacity to permit full water flow for a 3-hour period. In addition, a duplex filter of the same size should be installed in the bypass line. *(See Figure A.11.2.8.5.)*

A.11.3 The engine-driven pump can be located with an electric-driven fire pump(s) in a pump house or pump room that should be entirely cut off from the main structure by noncombustible construction. The fire pump house or pump room can contain facility pumps and/or equipment as determined by the authority having jurisdiction.

A.11.3.2 For optimum room ventilation, the air supply ventilator and air discharge should be located on opposite walls.

When calculating the maximum temperature of the pump room, the radiated heat from the engine, the radiated heat from the exhaust piping, and all other heat-contributing sources should be considered.

If the pump room is to be ventilated by a power ventilator, reliability of the power source during a fire should be considered. If the power source is unreliable, the temperature rise calculation should assume the ventilator is not operable.

Air consumed by the engine for combustion should be considered as part of the air changes in the room.

Pump rooms with heat exchanger–cooled engines typically require more air changes than engine air consumption can provide. To control the temperature rise of the room, additional air flow through the room is normally required. *[See Figure A.11.3.2(a).]*

Pump rooms with radiator-cooled engines could have sufficient air changes due to the radiator discharge and engine consumption. *[See Figure A.11.3.2(b).]*

A.11.3.2.3 When motor-operated dampers are used in the air supply path, they should be spring operated to the open position and motored closed. Motor-operated dampers should be signaled to open when or before the engine begins cranking to start.

It is necessary that the maximum air flow restriction limit for the air supply ventilator be compatible with listed engines to ensure adequate air flow for cooling and combustion. This restriction typically includes louvers, bird screens, dampers, ducts, and anything else in the air supply path between the pump room and the outdoors.

Motor-operated dampers are recommended for the heat exchanger–cooled engines to enhance convection circulation.

Gravity-operated dampers are recommended for use with radiator-cooled engines to simplify their coordination with the air flow of the fan.

Another method of designing the air supply ventilator in lieu of dampers is to use a vent duct (with rain cap), the top of which extends through the roof or outside wall of a pump house and the bottom of which is approximately 6 in. (152.4 mm) off the floor of the pump house. This passive method reduces heat loss in the winter. Sizing of this duct must meet the requirements of 11.3.2.1.

A.11.3.2.4 When motor-operated dampers are used in the air discharge path, they should be spring operated to the open

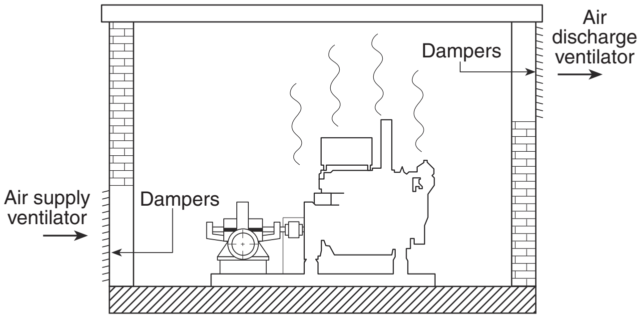


FIGURE A.11.3.2(a) Typical Ventilation System for a Heat Exchanger–Cooled Diesel-Driven Pump.

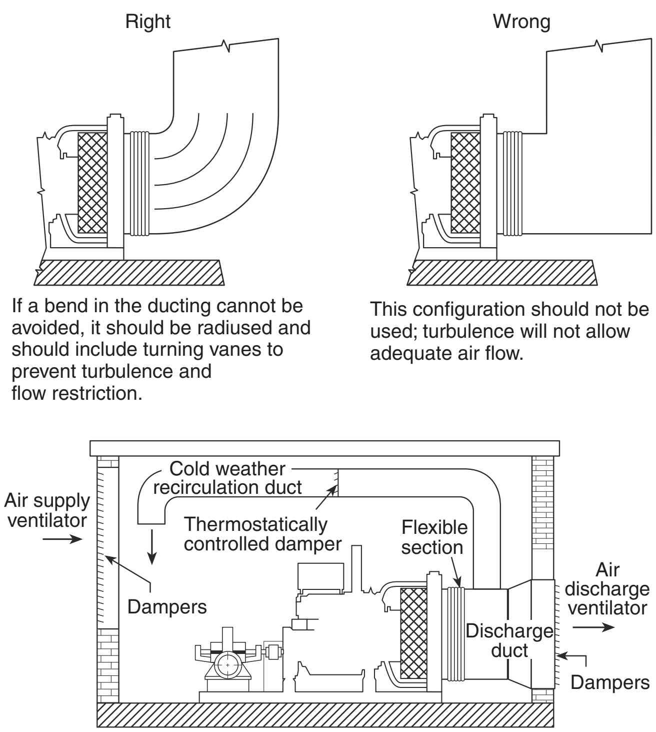


FIGURE A.11.3.2(b) Typical Ventilation System for a Radiator-Cooled Diesel-Driven Pump.

position, motored closed, and signaled to open when or before the engine begins cranking to start.

Prevailing winds can work against the air discharge ventilator. Therefore, the winds should be considered in determining the location for the air discharge ventilator. *(See Figure A.11.3.2.4 for the recommended wind wall design.)*

For heat exchanger–cooled engines, an air discharge ventilator with motor-driven dampers designed for convection circulation is preferred in lieu of a power ventilator. This arrangement requires the size of the ventilator to be larger, but it is not dependent on a power source that might not be available during the pump operation.

For radiator-cooled engines, gravity-operated dampers are recommended. Louvers and motor-operated dampers are not recommended due to the restriction to air flow they create and the air pressure against which they must operate.

The maximum air flow restriction limit for the air discharge ventilator is necessary to be compatible with listed engines to ensure adequate air flow cooling.

A.11.3.2.4.3.4 If not properly installed, the bypass duct can draw air rather than supply it, due to venturi effect.

A.11.4.1.2 The quantity 1 gal per hp (5.07 L per kW) is equivalent to 1 pint per hp (0.634 L per kW) per hour for 8 hours. Where prompt replenishment of fuel supply is unlikely, a reserve supply should be provided along with facilities for transfer to the main tanks.

A.11.4.1.3.1 Where the authority having jurisdiction approves the start of the fire pump on loss of ac power supply, provisions should be made to accommodate the additional fuel needed for this purpose.

A.11.4.3 Diesel fuel storage tanks preferably should be located inside the pump room or pump house, if permitted by local regulations. Fill and vent lines in such case should be extended

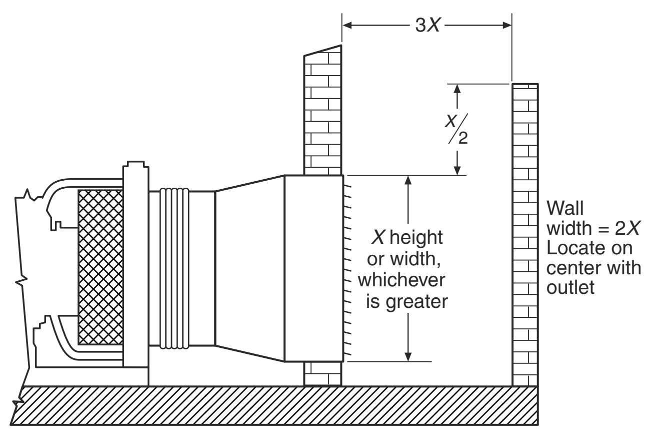
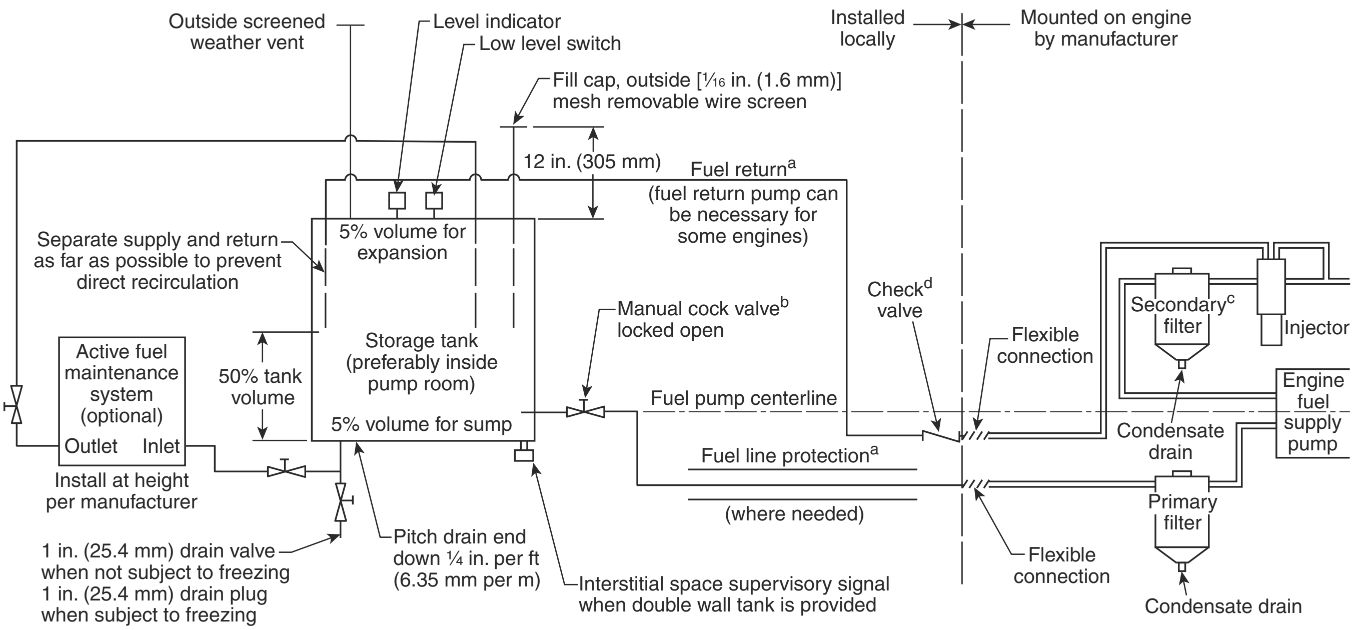


FIGURE A.11.3.2.4 Typical Wind Wall.



[a]Size fuel piping according to engine manufacturer's specifications.
[b]Excess fuel can be returned to fuel supply pump suction, only if recommended by engine manufacturer.
[c]Secondary filter behind or before engine fuel pump, according to engine manufacturer's specifications.
[d]Check valve in return only as required by engine manufacturer.

Δ **FIGURE A.11.4.4 Fuel System for Diesel Engine–Driven Fire Pump.**

to outdoors. The fill pipe can be used for a gauging well where practical.

A.11.4.4 NFPA 31 can be used as a guide for diesel fuel piping. Figure A.11.4.4 shows a suggested diesel engine fuel system.

A.11.4.4.6 A means, such as covered floor trough, angle, channel steel, or other adequate protection cover(s) (mechanical or nonmechanical), should be used on all fuel line piping "exposed to traffic," to prevent damage to the fuel supply and return lines between the fuel tank and diesel driver.

N **A.11.4.4.7** Paragraph 11.4.4.7 addresses a fuel shut-off solenoid that is a part of the engine fuel supply plumbing that would be installed for the purpose of normal stopping of the engine by starving it for fuel. The manual mechanical operation or bypass that is required is to provide the ability to allow fuel to be delivered to the engine in the event of failure of the solenoid valve itself or the control circuitry to it. The solenoid valve in this paragraph would be a part of the third-party listing of the engine and supplied by the engine supplier. Emergency stop is not the purpose for the solenoid valve in 11.4.4.7.

A.11.4.5 The pour point and cloud point should be at least 10°F (5.6°C) below the lowest expected fuel temperature. *(See 4.14.2 and 11.4.3.)*

A.11.4.5.1 Biodiesel and other alternative fuels are not recommended for diesel engines used for fire protection because of the unknown storage life issues. It is recommended that these engines use only petroleum fuels.

A.11.4.6 The prevention of electrostatic ignition in equipment is a complex subject. Refer to NFPA 77 for more guidance.

A.11.5.2 A conservative guideline is that, if the exhaust system exceeds 15 ft (4.5 m) in length, the pipe size should be increased one pipe size larger than the engine exhaust outlet size for each 5 ft (1.5 m) in added length.

A.11.5.2.9 Exhaust emission after treatment devices are typically dependent upon high exhaust temperature to burn away collected materials to prevent clogging. Due to the lower exhaust temperatures produced by the engine when operating at pump shutoff during weekly operation, there is a high possibility the after treatment device will accumulate collected material and will not be capable of flowing the volume of exhaust in the event the engine is required to produce full rated power for an emergency.

A.11.6 Internal combustion engines necessarily embody moving parts of such design and in such number that the engines cannot give reliable service unless given diligent care. The manufacturer's instruction book covering care and operation should be readily available, and pump operators should be familiar with its contents. All of its provisions should be observed in detail.

A.11.6.2 See NFPA 25 for proper maintenance of engine(s), batteries, fuel supply, and environmental conditions.

A.11.6.4 Commercial distillate fuel oils used in modern diesel engines are subject to numerous detrimental effects during storage. The origin of the crude oil, refinement processing techniques, time of year, and geographical consumption location all influence the determination of fuel blend formulas. Naturally occurring gums, waxes, soluble metallic soaps, water, dirt, blends, and temperature all contribute to the degradation of the fuel as it is handled and stored. These effects begin at the time of fuel refinement and continue until consumption. Proper maintenance of stored distillate fuel is critical for engine operation, efficiency, and longevity.

Storage tanks should be kept waterfree. Water contributes to steel tank corrosion and the development of microbiological growth where fuel and water interface. These problems together with the metals of the system provide elements that react with fuel to form certain gels or organic acids, resulting in clogging of filters and system corrosion. Scheduled fuel maintenance helps to reduce fuel degradation. Fuel maintenance filtration can remove contaminants and water and maintain fuel conditions to provide reliability and efficiency for standby fire pump engines. Fuel maintenance and testing should begin the day of installation and first fill.

A.11.6.4.3 NFPA 25 requires periodic testing of the fuel and maintenance of the fuel supply tank to ensure quality fuel is always available to the engine for fire protection operation.

A.11.6.4.4 When environmental or fuel quality conditions result in degradation of the fuel while stored in the supply tank from such contaminants as water, micro-organisms, and particulates, or by destabilization, it has been found that active fuel maintenance systems permanently installed on the fuel storage tanks have proven to be successful at maintaining fuel quality. An active fuel maintenance system will maintain the fuel quality in the tank, therefore preventing the fuel from going through possible cycles of degradation, risking engine reliability, and later requiring reconditioning.

A.11.6.5 Proper engine temperature, in accordance with 11.2.8.2 and 11.6.5.1, maintained through the use of a supplemental heater has many benefits, as follows:

(1) Quick starting (a fire pump engine might have to carry a full load as soon as it is started)
(2) Reduced engine wear
(3) Reduced drain on batteries
(4) Reduced oil dilution
(5) Reduced carbon deposits, so that the engine is far more likely to start every time

A.12.2.1 If the controller must be located outside the pump room, a glazed opening should be provided in the pump room wall for observation of the motor and pump during starting. The pressure control pipeline should be protected against freezing and mechanical injury.

A.12.3.1.1 In areas affected by excessive moisture, heat can be useful in reducing the dampness.

A.12.3.3.1 For more information, see NEMA 250, *Enclosures for Electrical Equipment.*

A.12.3.8 Pump operators should be familiar with instructions provided for controllers and should observe in detail all their recommendations.

A.12.4.1.2 It is recommended that the pilot lamp for signal service have operating voltage less than the rated voltage of the lamp to ensure long operating life. When necessary, a suitable resistor should be used to reduce the voltage for operating the lamp.

A.12.4.1.4(1) The controller can set the signal trip point above the two-thirds level. But, higher than ¾ of nominal is not recommended to avoid false signals during normal battery aging.

A.12.4.1.4(6) The signal provided is from a common alarm and the indication of the type of trouble happening should be indicated on the engine.

A.12.4.1.6 This automatic reset function can be accomplished by the use of a silence switch of the automatic reset type or of the self-supervising type.

Δ **A.12.4.2.3(3)** The following signals should be monitored remotely from the controller:

(1) A common signal can be used for the following trouble indications: the items in 12.4.1.4(1) through 12.4.1.4(7) and loss of output of battery charger on the load side of the dc overcurrent protective device.
(2) The arrangement specified in A.12.4.2.3(3)(2) is permitted only where approved by the authority having jurisdiction in accordance with Section 1.5 and allows, upon loss of the ac power supply, the batteries to maintain their charge, activates ventilation in case conditions require cooling the engine, and/or maintains engine temperature in case conditions require heating the engine. *(See also A.4.6.4 and A.11.4.1.3.1.)*

A.12.4.4 The pressure recorder should be able to record a pressure at least 150 percent of the pump discharge pressure under no-flow conditions. In a high-rise building, this requirement can exceed 400 psi (27.6 bar). This requirement does not mandate a separate recording device for each controller. A single multichannel recording device can serve multiple sensors.

A.12.7 The following definitions are derived from *NFPA 70*:

(1) *Automatic.* Self-acting, operating by its own mechanism when actuated by some impersonal influence (e.g., a change in current strength, pressure, temperature, or mechanical configuration).
(2) *Nonautomatic.* The implied action requires personal intervention for its control. As applied to an electric controller, nonautomatic control does not necessarily imply a manual controller, but only that personal intervention is necessary.

N **A.12.7.2.1.1.2** Water piping and associated devices could be attached to the outside of the controller.

A.12.7.2.1.3 The purpose of monitoring pressure readings from a pressure transducer is to detect and correct a transducer that is operating outside of the expected pressure range.

A.12.7.2.1.3.1 The purpose of monitoring the pressure transducer is to detect whether a transducer has drifted upwardly over time from zero. A transducer that drifts downwardly will automatically cause the fire pump to start when it drifts below the start set point.

A.12.7.2.1.3.2 When the solenoid valve drain opens, the restricting orifice in the pressure sensing line will keep the pressure at the transducer near zero while the solenoid valve is open. This is the time when the transducer can be verified to be less than 10 psi.

A.12.7.5.2 Manual shutdown of fire pumps is preferred. Automatic fire pump shutdown can occur during an actual fire condition when relatively low-flow conditions signal the controller that pressure requirements have been satisfied.

A.12.7.5.2.1(1) Although the pump is allowed to start and stop automatically during churn testing, 4.3.1 requires qualified person(s) to be in the pump room to monitor conditions while the pump is running.

A.12.7.5.2.2 A run time of 30 to 45 minutes is usually long enough to dry out the exhaust system and bring the engine and oil up to normal operating temperatures to dry them out. Longer times could require larger fuel tanks.

A.13.1.3 Single-stage turbines of maximum reliability and simplicity are recommended where the available steam supply will permit.

A.13.2.1.1 The casing can be of cast iron.

Some applications can require a turbine-driven fire pump to start automatically but not require the turbine to be on pressure control after starting. In such cases, a satisfactory quick-opening manual reset valve installed in a bypass of the steam feeder line around a manual control valve can be used.

Where the application requires the pump unit to start automatically and after starting continue to operate by means of a pressure signal, the use of a satisfactory pilot-type pressure control valve is recommended. This valve should be located in the bypass around the manual control valve in the steam feeder line. The turbine governor control valve, when set at approximately 5 percent above the normal full-load speed of the pump under automatic control, would act as a pre-emergency control.

In the arrangements set forth in the two preceding paragraphs, the automatic valve should be located in the bypass around the manual control valve, which would normally be kept in the closed position. In the event of failure of the automatic valve, this manual valve could be opened, allowing the turbine to come to speed and be controlled by the turbine governor control valve(s).

The use of a direct acting pressure regulator operating on the control valve(s) of a steam turbine is not recommended.

A.13.3 The following information should be taken into consideration when planning a steam supply, exhaust, and boiler feed for a steam turbine–driven fire pump.

The steam supply for the fire pump should preferably be an independent line from the boilers. It should be run so as not to be liable to damage in case of fire in any part of the property. The other steam lines from the boilers should be controlled by valves located in the boiler room. In an emergency, steam can be promptly shut off from these lines, leaving the steam supply entirely available for the fire pump. Strainers in steam lines to turbines are recommended.

The steam throttle at the pump should close against the steam pressure. It should preferably be of the globe pattern with a solid disc. If, however, the valve used has a removable composition ring, the disc should be of bronze and the ring made of sufficiently hard and durable material, and so held in place in the disc as to satisfactorily meet severe service conditions. Gate valves are undesirable for this service because they cannot readily be made leaktight, as is possible with the globe type of valve. The steam piping should be so arranged and trapped that the pipes can be kept free of condensed steam.

In general, a pressure-reducing valve should not be placed in the steam pipe supplying the fire pump. There is no difficulty in designing turbines for modern high-pressure steam, and this gives the simplest and most dependable unit. A pressure-reducing valve introduces a possible obstruction in the steam line in case it becomes deranged. In most cases, the turbines can be protected by making the safety valve required by 13.2.1.2 of such size that the pressure in the casing will not exceed 25 psi (1.7 bar). This valve should be piped outside of the pump room and, if possible, to some point where the discharge could be seen by the pump attendant. Where a pressure-reducing valve is used, the following points should be carefully considered:

(1) *Pressure-Reducing Valve.*
   (a) The pressure-reducing valve should not contain a stuffing box or a piston working in a cylinder.
   (b) The pressure-reducing valve should be provided with a bypass containing a globe valve to be opened in case of an emergency. The bypass and stop valves should be one pipe size smaller than the reducing valve, and they should be located so as to be readily accessible. This bypass should be arranged to prevent the accumulation of condensate above the reducing valve.
   (c) The pressure-reducing valve should be smaller than the steam pipe required by the specifications for the turbine.

(2) *Exhaust Pipe.* The exhaust pipe should run directly to the atmosphere and should not contain valves of any type. It should not be connected with any condenser, heater, or other system of exhaust piping.

(3) *Emergency Boiler Feed.* A convenient method of ensuring a supply of steam for the fire pump unit, in case the usual boiler feed fails, is to provide an emergency connection from the discharge of the fire pump. This connection should have a controlling valve at the fire pump and also, if desired, an additional valve located in the boiler room. A check valve also should be located in this connection, preferably in the boiler room. This emergency connection should be about 2 in. (50 mm) in diameter.

This method should not be used when there is any danger of contaminating a potable water supply. In situations where the fire pump is handling salt or brackish water, it might also be undesirable to make this emergency boiler feed connection. In such situations, an effort should be made to secure some other secondary boiler feed supply that will always be available.

A.14.1.1 The suction piping to a fire pump needs to be adequately flushed to make sure stones, silt, and other debris will not enter the pump or the fire protection system. The flow rates in Table 14.1.1.1 are the minimum recommended, which will produce a velocity of approximately 15 ft/sec (4.6 m/sec). If the flow rate cannot be achieved with the existing water supply, a supplemental source such as a fire department pumper could be necessary. The procedure is to be performed, witnessed, and signed off before connection to the suction piping is completed.

A.14.1.3 See Figure A.14.1.3(a) for a sample of a contractor's material and test certificate for fire pumps and Figure A.14.1.3(b) for a sample certificate for private fire service mains.